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**Forest
Service**

Southwestern
Region

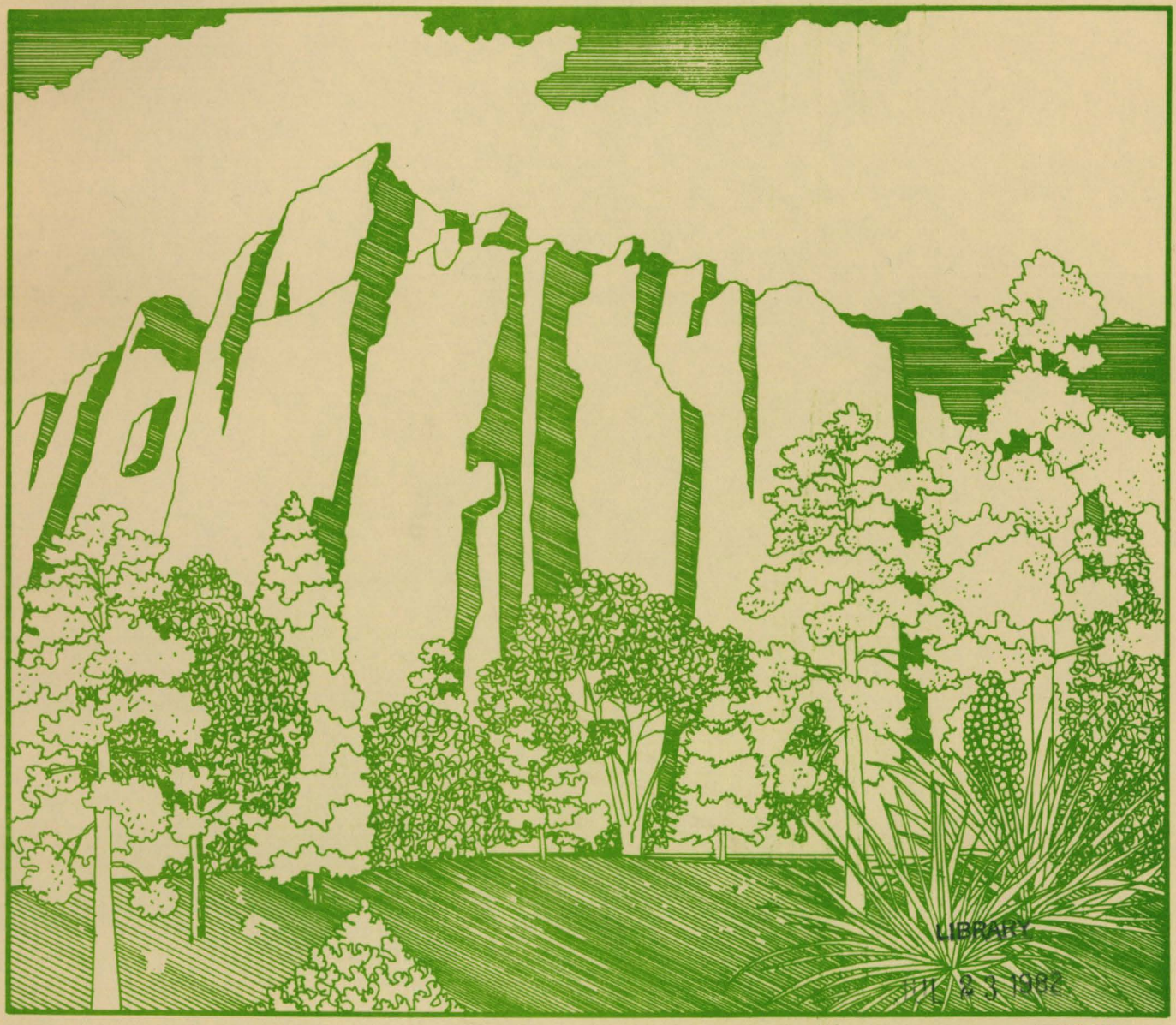
Forest Pest Management Report

R-3 82-9

BIOLOGICAL EVALUATION
Root Disease and Southwestern Dwarf Mistletoe
Compartment 317.1

Jemez Ranger District
Santa Fe National Forest
New Mexico

June 1982



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Forest Pest Management
State and Private Forestry
Southwestern Region, USDA Forest Service
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SUMMARY

A survey of 500 acres on the Jemez Ranger District determined that the root disease caused by Armillariellia mellea is causing significant mortality to sawtimber-, pole-, and sapling-sized ponderosa pines. Area out of production, volume losses, and number and sizes of trees killed by root diseases were ascertained. Southwestern dwarf mistletoe was present in part of the stand. Management alternatives for these diseases are presented, and the need for additional evaluation of this stand is discussed.

INTRODUCTION

At the request of Bill Steensen, District Timber Staff, Forest Pest Management and District personnel conducted a survey of approximately 500 acres on the Jemez Ranger District, roughly corresponding to compartment 317.1, bounded by State Highway 4 on the south, and the East Fork of the Jemez River on the north, in sec. 1, T. 18 N., R. 3 E., and sec. 6, T. 18 N., R. 4 E. The purpose of the survey was to determine the area out of production due to the presence of root diseases, the volume of timber killed, and the numbers of seedlings, saplings, and poles killed by root disease organisms.

Site and Stand Characteristics

Topography of the site is gently rolling, bounded on the north by steep north slopes, at the bottom of which is the East Fork of the Jemez River (figs. 1 and 2). Elevations range from 8,580 feet on the eastern edge to 8,100 feet at the western boundary. An intermittent stream flows through the stand from east to west.

Vegetation consists of a scattered overstory of ponderosa pine (Pinus ponderosa), 120 to 140 years old, which was logged 8 years ago as part of the East Fork sale. Aspen groves are small and scattered, occurring mainly on north slopes near the intermittent stream or in the stream bottom. Understory trees consist of sapling- and pole-sized ponderosa pines with scattered white firs (Abies concolor), Douglas-firs (Pseudotsuga taxifolia), and limber pines (Pinus flexilis). Seedling density is low in the eastern half of the stand, but gradually increases toward the western end to 2,000 stems per acre. The understory was thinned after the sale in FY 1974. Site index for the compartment is 90.

Diseases

Armillaria root rot, caused by Armillariella mellea, and southwestern dwarf mistletoe, Arceuthobium vaginatum var. cryptopodum, were the only diseases found to be causing significant mortality in the compartment.

Armillariella mellea is a common pathogen which infects a very wide range of hosts, including hardwoods and conifers. It often colonizes stumps or the roots and basal portions of dead trees and spreads to live trees by means of root contacts or grafts, or more often by rhizomorphs (small black shoestringlike structures which can grow through soil for some distance). When rhizomorphs contact live roots, they serve to create new infections. Vigorous hosts are able to resist the pathogen; trees stressed by stand and site conditions, or by other diseases or insects, or those damaged by logging, are often unable to do so. Bark beetles may then detect diseased trees and attack them and/or adjacent trees, enlarging the mortality center. Armillariella can survive for many years in roots, infecting and killing regeneration which subsequently becomes established.

Southwestern dwarf mistletoe is the most important pathogen in the Southwest. It causes growth losses in its only host, ponderosa pine, which increase with intensity of infection until the host dies, or, as is usually the case, becomes infested with bark beetles and then dies. This pathogen spreads to new hosts and intensifies within a host by small seeds which are forcibly expelled outward and upward for as much as 100 feet, the actual distance depending on the angle of expulsion, the height of the parasite in the tree, and a number of other factors.

METHODS

The survey combined a 10 percent strip cruise and prism plots. One-chain-wide strips, oriented north and south, were located every 10 chains. All trees located within the strips, or whose crowns intercepted strips, were inspected, and, if dead, dying, or expressing symptoms typical of root diseases, were more closely examined. This examination consisted of looking for signs and symptoms of root diseases, including resinosis, staining, mycelial mats, decay, and fruiting bodies, at the root collar or distal on the roots for a distance of about 3 feet. Nearby stumps were examined for the presence of root diseases. When an active infection center was identified, its area was estimated and recorded. Infected stumps not having associated mortality were not considered infection centers.

Prism plots were established, using a 10 BAF prism, every 5 chains along the centerline of the cruise strips.

Trees

All trees within the prism plots were counted and the following data recorded: tree species, diameter, condition, diseases, and insects. Condition classes were live, fading, new mortality, old mortality, and stump. One one-hundredth (1/100)-acre plots, having the same centers as the prism plots, were established to determine seedling densities.

RESULTS

A summary of the losses caused by Armillaria root disease is as follows:

Sawtimber	1,082 board feet/acre	9.8%
Saplings and poles (<9 inches d.b.h.)	28 stems/acre	12%
Seedlings (<4.5 feet in height)		1%
Area out of production	9.9 acres	2%

The estimate of trees killed includes only those which died since the compartment was logged and live trees which expressed symptoms; furthermore, trees of either class were included only when they contained signs of the pathogen at or near the root collar. Since signs quickly disappear following death, especially in smaller trees and seedlings, and usually cannot be seen for more than 2 to 4 years, the estimate does not include trees killed soon after logging. In addition, signs of the fungus on both dead and dying trees are often not visible without completely excavating and inspecting roots; the estimate of mortality caused by Armillaria root disease is, therefore, undoubtedly lower than the actual mortality. Possible growth losses prior to mortality, which would indicate additional volume losses, were not measured. The apparent discrepancy between sawtimber killed and area out of production reflects our inability to adequately measure the latter with the survey procedure used; the actual area out of production is probably larger than our estimate.

Dwarf mistletoe was found on 18 percent of the trees located on all prism plots, but was located on 22 percent of the plots; the infection rate in infected plots was 64 percent, with an average dwarf mistletoe rating (DMR) of 2.8, using Hawksworth's 6-class system. Dwarf mistletoe is infecting approximately 125 acres of the compartment; in infected stands, it is moderate in severity; some growth loss can be expected along with mortality, both of which will increase over time. The most serious consequence of the mistletoe in this compartment is the source of infection of the understory.

The prescriptions written for this compartment in 1965 reflected the current state of knowledge of dwarf mistletoe and, if followed, would have significantly reduced the impact of the parasite. It appears that the prescriptions were not carried out.

ALTERNATIVES AND CONSEQUENCES

Armillaria Root Disease

1. Current Management

Overstory trees in and around infection centers will continue to die at a slightly declining rate as inoculum potential decreases. Understory trees which are now established or which will become established in the future will die at an increasing rate as their roots contact inoculum sources. Seedling mortality will continue to occur until the fungus exhausts food supplies provided by infected stumps and dies out.

2. Salvage

Immediate entry into the compartment for the purpose of removing salvageable dead and dying trees would reduce losses by insuring the utilization of some of the mortality. Salvage operations would have no effect on the course of the epidemic, which would continue to kill trees at approximately the same rate as with current management.

3. Site Rehabilitation

Armillaria root disease infection courts have been eradicated from stands in the Pacific Northwest by removing all stumps following logging. The site is then replanted to conifers. This technique is expensive and has not been tested in the Southwest, although there is no reason to believe that it would not work in this Region. The benefit is that sites now out of production, and which will remain out of production for as much as 40 years, can be regenerated. In addition, the disruption caused by stump removal also serves as effective site preparation.

Costs of stump removal have not been determined for the Southwest. In the ponderosa pine type in Washington State, appropriate costs are $2.40 per stump, using a D-8 size machine.

The customary procedure in discrete, identifiable centers is as follows: All trees should be cut within each infection center and in a barrier strip around the center. The width of the barrier strip should vary with the size of trees cut. In Washington State, suggested barrier widths are 15, 18, and 23 feet for average tree diameters of 5, 9, and 11 inches. Observations indicate that the rooting zones of ponderosa pines are greater in the Southwest than in the Pacific Northwest. The extent of rooting zones could be estimated by excavating representative root systems to determine their extent.

All stumps within centers and in buffer strips around centers are then pushed, using a track-type tractor equipped with a splitter attachment and a ripper blade. Pushing should only be done in dry weather.

A modification of the above treatment, which has not been tested but which appears to be feasible and less expensive, is the use of a large disc, such as is used in site preparation, to disrupt stumps and roots, opening the way for organisms antagonistic to Armillaria to occupy suitable substrates. Observations indicate that the disc now in use on the Jemez Ranger District disrupts stumps and shallow roots to a large degree, but the effects of the treatment on inoculum potential and subsequent killing of regeneration have not been determined.

Dwarf Mistletoe

1. Current Management

Infected overstory will continue to infect accessible understory trees. The pathogen will slowly spread from infected into uninfected areas. Although the pathogen is only moderately affecting the stand now, the consequences of spread and intensification are severe growth losses and mortality within the next 20 to 30 years.

2. Overstory Removal

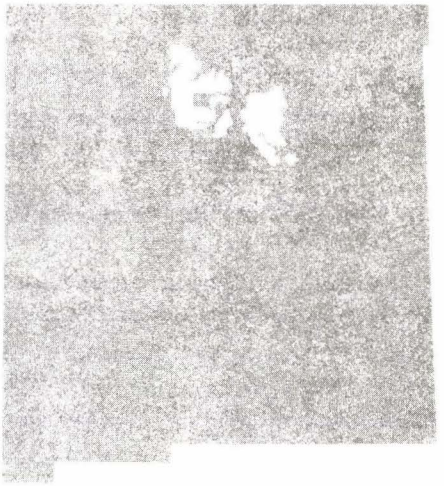
The prescriptions written in 1965 called for complete overstory removal in infected stands. This remains a valid alternative, which might be modified by removing only infected trees; although it would remove the overstory from some stands adjacent to Highway 4, those trees will eventually die anyway after heavily infecting the understory. Removal followed by a thinning, if necessary, to remove heavily infected understory trees, would produce a relatively healthy stand.

RECOMMENDATIONS

The fact that this compartment is located next to Highway 4, and contains many large yellow pines of value for scenic purposes, adds to the difficulty of selecting the best alternative to be followed. However, the extent and severity of diseases are such that if nothing is done, the present understory, which will enhance the site in the future, will suffer the same decline as the overstory, but much more rapidly. Accordingly, we recommend that stump removal and disruption be tested in selected root disease centers in the compartment in order to determine the efficacy and costs of the treatment. We further recommend that root disease mortality be salvaged concurrently with removal of the dwarf mistletoe-infected overstory following the prescriptions written in 1965.

Region 3
USDA Forest Service

State of New Mexico



Santa Fe National Forest

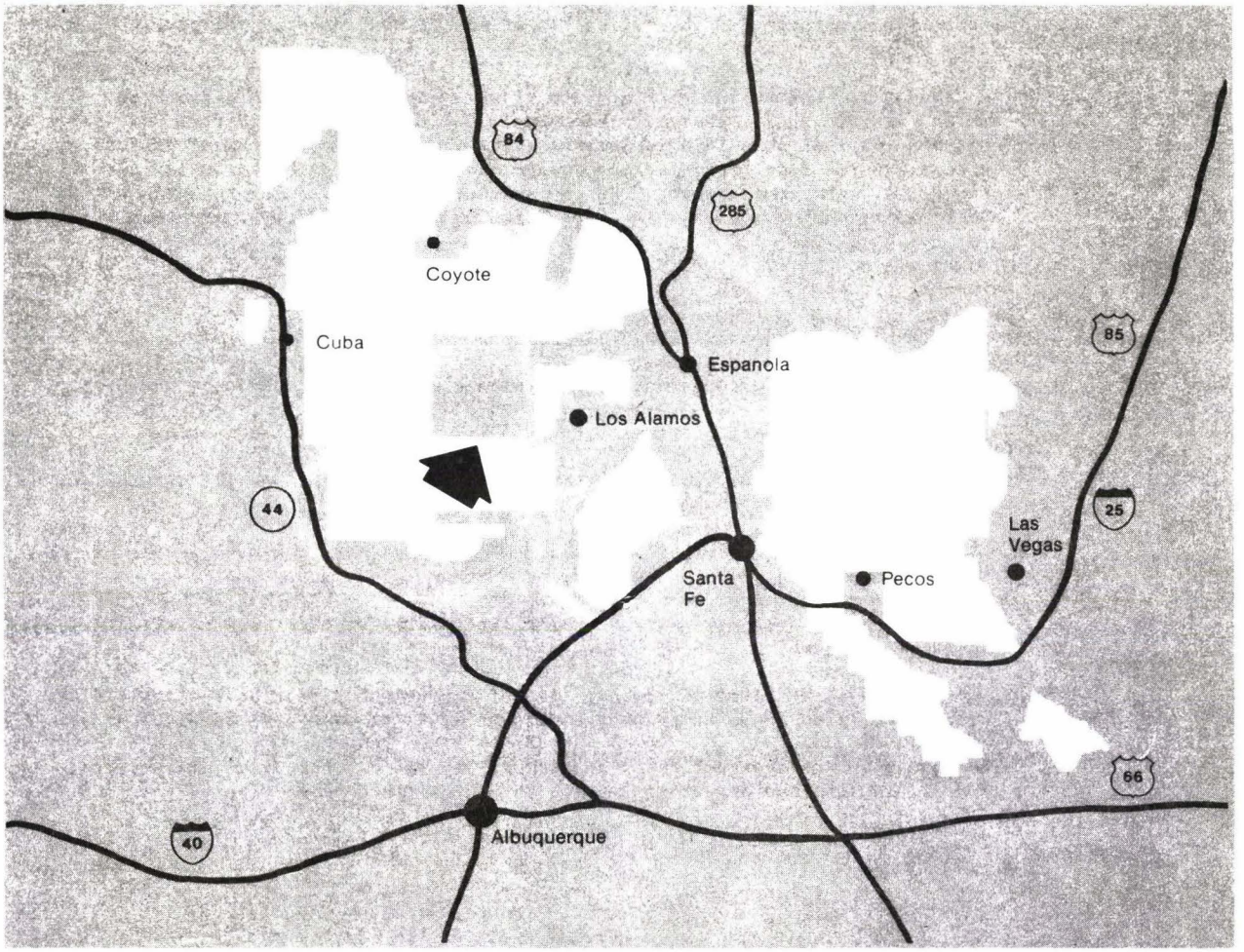


Figure 1. Vicinity Map

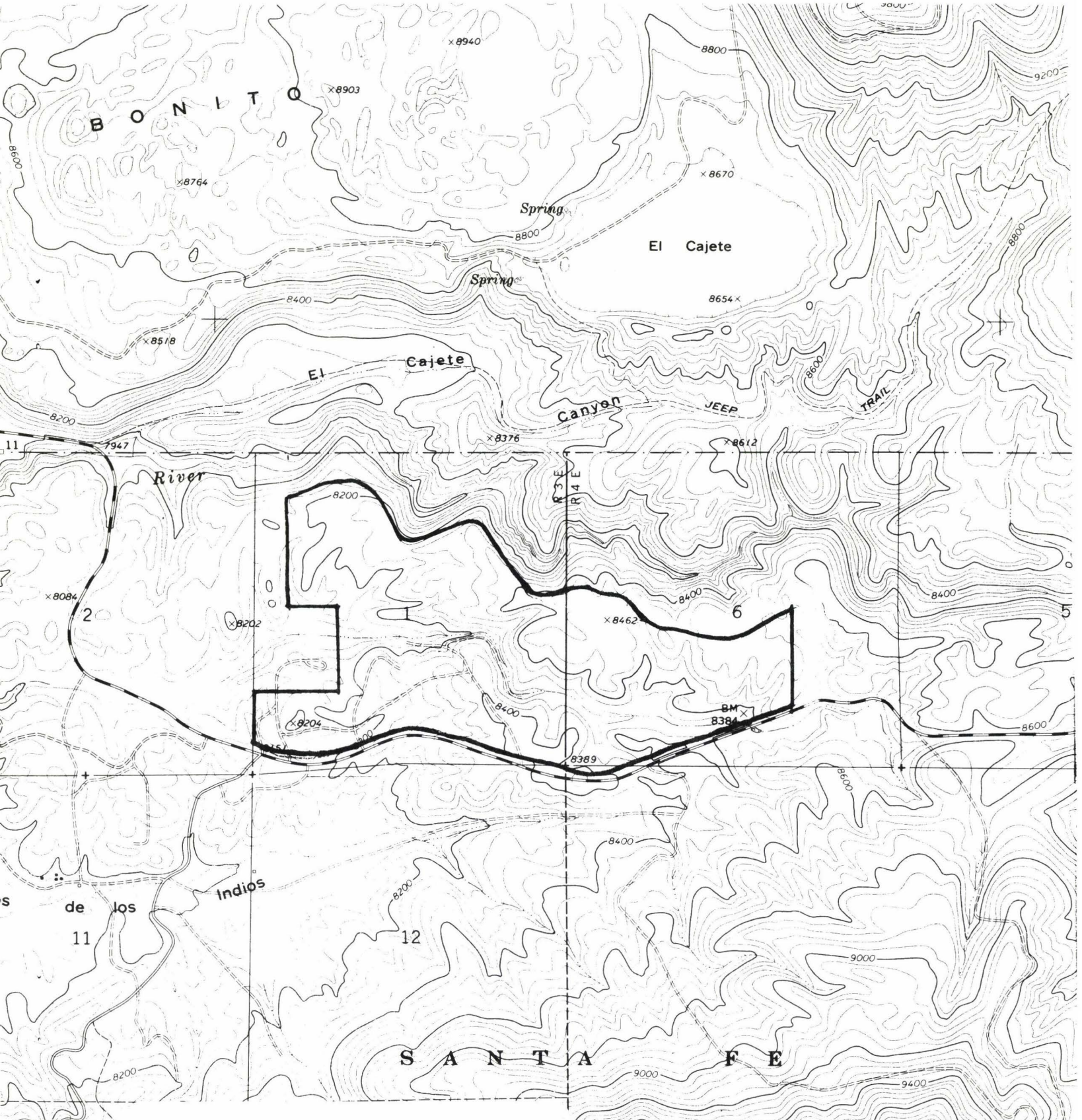


Figure 2.--Area surveyed.